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(54) Title: BATTERY CASE FEEDTHROUGH

(57) Abstract: A method and apparatus for providing a hermetically sealed electrical feedthrough for use with a metal battery case The apparatus includes a ceramic-metal feedthrough subassembly, a metal case o flow melt point material, and a clad metal case cover comprised of a first layer of high melt point material and a second layer of low melt point material. The first layer is hermetically sealed to the case and the second layer is hermetically sealed to a collar on the feedthrough subassembly.

TITLE: BATTERY CASE FEEDTHROUGH

INVENTOR: HISASHI TSUKAMOTO

FIELD OF THE INVENTION

This invention relates to a battery case feedthrough and more particularly to a method and apparatus for providing a hermetically sealed electrical feedthrough for use with a metal battery case of low melt point material.

BACKGROUND OF THE INVENTION

Battery cases typically require a conductive pin which feeds into the case through a dielectric material which insulates the pin from the conductive case wall. It is generally critical that the feedthrough be hermetically sealed. Techniques are known for forming a hermetic seal between a metal pin of high melt point material and a ceramic cylinder surrounding the pin. Moreover, an annular metal collar of high melt point material can be hermetically sealed around the ceramic cylinder.

It is often desirable to be able to form a battery case of light weight low cost material, such as aluminum. Unfortunately, aluminum melts at a temperature lower than the temperatures normally required to fabricate and install the aforedescribed ceramic-metal feedthrough structure in the case. For example, the fabrication of the aforedescribed structure typically requires the application of a temperature of about 800° C or more to form a hermetic seal between two high melt point metals and/or between a high melt point metal and a ceramic cylinder. Such an elevated temperature could destroy a case formed of aluminum which melts just above 600° C.

SUMMARY OF THE INVENTION

The present invention is directed to an improved case/feedthrough construction enabling the use of a low melt point case material, e.g., aluminum, in conjunction with a ceramic-metal feedthrough subassembly which requires the application of a high temperature to form a hermetic seal.

In accordance with the invention, a case cover comprised of a layer of high melt point material and a layer of low melt point material is used to respectively seal to a high melt point collar on the feedthrough subassembly and a low melt point case.

More particularly, in accordance with a preferred embodiment, a case cover is formed of clad metal comprised of a layer of high melt point material, e.g., stainless steel or titanium, and a layer of low melt point material, e.g., aluminum. A feedthrough hole is formed through the cover. The feedthrough subassembly annular collar is aligned with the hole and hermetically sealed to the clad metal high melt point layer using a high temperature welding process. The clad metal low melt point layer, e.g., aluminum, can be laser welded to the aluminum case at a lower temperature to form a hermetic seal.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 is an exploded sectional view of a feedthrough subassembly, a battery case, and a case cover in accordance with the invention formed of clad metal; and

Figure 2 is a sectional view similar to Figure 1 but showing the feedthrough subassembly, case, and case cover assembled together.

DETAILED DESCRIPTION

The following text describes the preferred mode presently contemplated for carrying out the invention and is not intended to describe all possible modifications and variations consistent with the spirit and purpose of the

invention. The scope of the invention should be determined with reference to the claims.

Figure 1 depicts a feedthrough subassembly 10 comprised of a feedthrough metal pin 1 penetrating a cylindrical ceramic glass core 2. A hermetic seal can be formed between the ceramic and metal by proper application of processes and materials.

Ceramic to stainless and ceramic to titanium are particular examples of materials that can be bonded to form hermetic seals. Braze bonding, for example, aluminum oxide and zirconium oxide ceramic to metals, including titanium, stainless steel, molybdenum, tantalum, and cobalt-chromium alloys, can be done using a braze, comprising 30% nickel and 70% titanium (U.S. Provisional Patent Application, Serial No._____; U.S. Patent Application, Serial No._____). Another example of a braze bond includes the preferred method for joining zirconium oxide containing 3% yttrium to preferably a metal alloy, namely titanium and niobium (55% Ti and 45% Nb), using the nickel-titanium braze (50% Ni and 50% Ti) (U.S. Provisional Patent Application, Serial No._____; U.S. Patent Application, Serial No._____).

Thus, by selecting a pin 1 of stainless steel or titanium or one of the other aforementioned metals and a ceramic core 2 of aluminum oxide or zirconium oxide, the pin 1 and core 2 can be hermetically bonded utilizing a high temperature brazing or baking process. Similarly, an annular collar 3 of stainless steel or titanium or one of the other aforementioned metals can be hermetically sealed around the core 2.

In accordance with the invention, a clad metal case cover 20 is provided to mount the feedthrough subassembly 10 relative to a case 30 formed of a light weight low cost metal, e.g., aluminum. The case cover 30 is formed of a first layer 4 of a high melt point material, e.g., stainless steel or titanium and a second layer 5 of a low melt point material, e.g., aluminum.

There are different methods for forming clad metal, such as a plate of stainless steel clad with aluminum. In one method (U.S. Patent No. 4213558,

Hirobe, et al.), sheet metal cladding is fed onto one or both faces of the hot solidified continuously cast strip being withdrawn from the casting means and the assembly is then passed to a hot roll bonding system for cladding. Another method (U.S. Patent No. 4966748, Miyasaka et al.) produces a clad metal by forming a layer of the dissimilar metal powder on the surface of a base metal by cold fixing the powder to the surface under pressure, denting only the surface and a subsurface area of the layer of the dissimilar metal powder by melting and immediately solidifying in a vacuum, compressing the layer of the dissimilar metal powder together with the base metal at a temperature not higher than the solidus-line temperature of the two dissimilar metals under a pressure of not lower than kgf/cm^2 using a hot isostatic press, and hot working the layer of the dissimilar metal power together with the base metal.

The case cover 20 defines a feedthrough mounting hole 6 of smaller diameter through layer 4 and larger diameter through layer 5. The feedthrough subassembly 10 is aligned with the hole 6 to place the annular collar 3 contiguous with the upper surface of case cover layer 4. Inasmuch as these contiguous materials are both formed of high melt point materials, e.g., stainless steel to titanium, they can be welded together using a high temperature process to form a hermetic seal. This high temperature is in excess of the melting point of the low melt point case material, e.g., aluminum. The case cover lower layer 5 of aluminum can then be welded to the aluminum case 7 using a lower temperature to form a hermetic seal.

If the clad metal were not used, the high temperature required to hermetically bond the feedthrough pin subassembly to the case would require use of a high melt point case cover. However, in trying to bond the high melt point cover to the aluminum case, the welding, or brazing, temperature would melt the aluminum. Exemplary melting point temperatures of the various metals are aluminum 660.37° C, stainless steel-303, 1427°C, and titanium 1660 +/- 10° C. In Figure 2, Low temperature hermetic welds are shown at (11) and (12). High temperature welds are shown at (13) and (14).

While the invention herein disclosed has been described by means of specific embodiments and applications thereof, numerous modifications and variations could be made thereto by those skilled in the art without departing from the scope of the invention set forth in the claims.

CLAIMS

1. In combination:

a case formed of a metal material having a first melting point;

a feedthrough structure including a core of ceramic material, a metal pin extending through said core and hermetically sealed thereto, and an annular metal collar surrounding said core and hermetically sealed thereto, said collar comprising a material having a second melting point greater than said first melting point.

a case cover comprising first and second clad metal layers, said first layer comprising a material having a melting point similar to that of said case material and said second layer comprising a material having a melting point similar to that of said collar material;

said case collar defining a hole extending therethrough;

means hermetically sealing said collar to said case cover second layer around said hole; and

means hermetically sealing said case cover first layer to said case.

2. The combination of claim 1 wherein said annular collar material is selected from a group consisting of stainless steel and titanium.

3. The combination of claim 1 wherein said ceramic material is selected from a group consisting of aluminum oxide and zirconium oxide.

4. The combination of claim 1 wherein said case material comprises aluminum.

5. The combination of claim 1 wherein said case cover first layer material comprises aluminum and said second layer material is selected from a group consisting of stainless steel and titanium.

6. The combination of claim 1 wherein said means hermetically sealing said collar to said case cover second layer comprises a high temperature weld; and

Said means hermetically sealing said case cover first layer to said case comprises a low temperature weld.

7. A battery feedthrough comprising a center conducting pin made from a metal selected from the group consisting of stainless steel and titanium; and electrical insulator made from a ceramic selected from the group consisting of aluminum oxide and zirconium oxide; said pin and said ceramic surrounded by a hollow cylinder of a metal selected from the group consisting of stainless steel and titanium, wherein said pin, said ceramic, and said surrounding metal hollow cylinder form a feedthrough-pin assembly; said feedthrough-pin assembly fitted through a hole in a clad metal cover slightly larger than the feedthrough-pin assembly; said clad metal being aluminum on the side facing toward a cylindrical aluminum battery casing; said upper clad surface being the same metal selected from the outer metal cylinder of the feedthrough-pin assembly.

8. The battery feedthrough as in claim 7 wherein the lower aluminum part of the clad cover does not meet the feedthrough-pin assembly.

9. The battery feedthrough as in claim 8 wherein the upper clad surface, which is a metal selected from the group consisting of stainless steel and titanium, is welded to the outer cylinder of the feedthrough-pin assembly.

10. The battery feedthrough as in claim 9 wherein the upper stainless steel to titanium part of the clad cover-to-outer cylinder of feedthrough-pin assembly weld is hermetic.

11. The battery feedthrough as in claim 10 wherein the lower aluminum part of the clad cover is welded to the aluminum battery casing.

12. The battery feedthrough as in claim 11 wherein the lower aluminum part of the clad cover is welded to the aluminum battery casing.

13. The battery feedthrough as in claim 12 wherein the lower aluminum part of the clad cover-aluminum battery casing weld is hermetic.

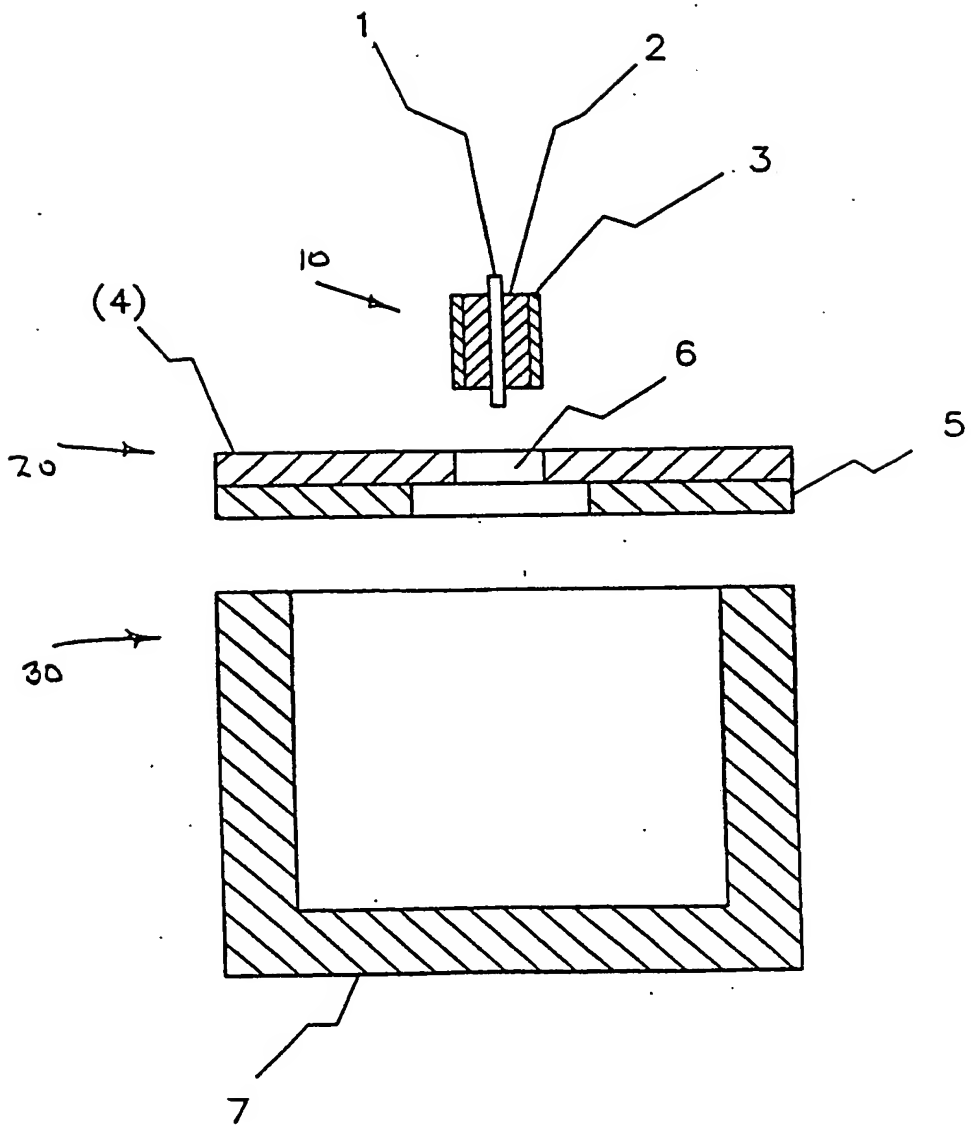

Fig. 1

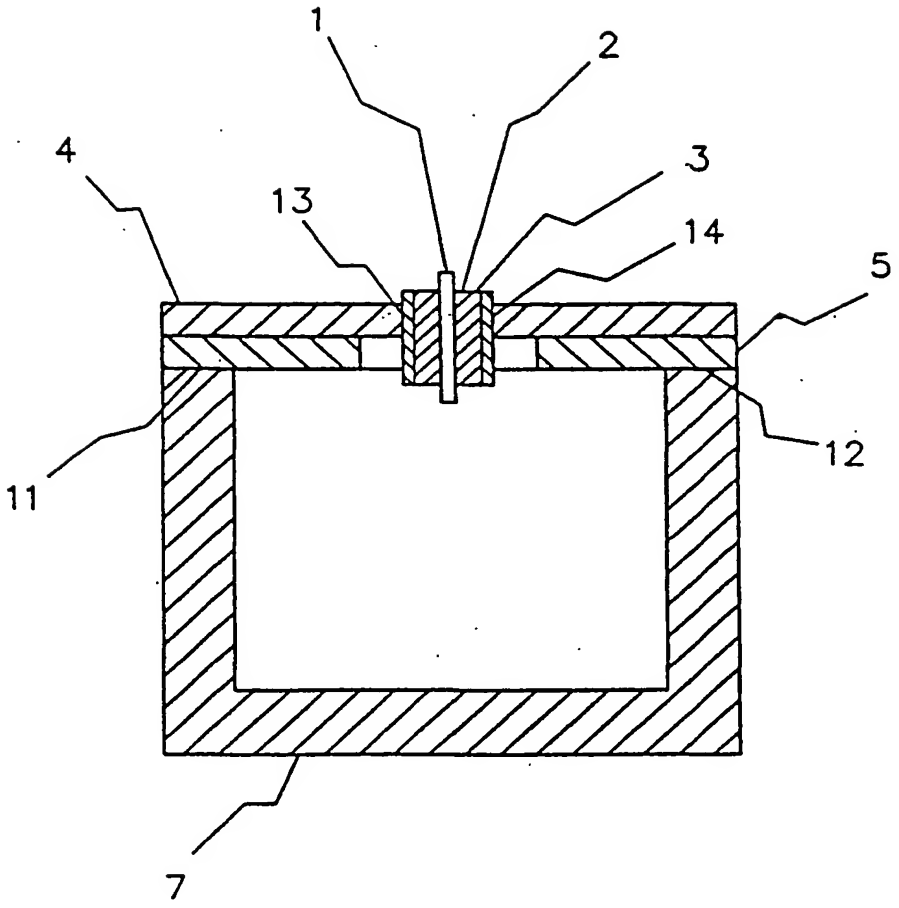

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/20598

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) :Please See Extra Sheet.
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 429/181, 184, 178, 185, 133, 157, 164; 174/50, 50.55, 50.58, 50.61, 61, 152G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WEST, EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,811,206 A (SUNDERLAND et al) 22 September 1998, abstract, col. 6, lines 44-67, col. 7, lines 2-33, col. 8, lines 9-12 & 50-52, figures 5a-5d.	1-13
Y	US 5,500,026 A (HELLER et al) 19 March 1996, col. 2, lines 17-42, figure 4.	1-13
Y	US 5,535,097 A (RUBEN et al) 09 July 1996, col. 3, line 58 to col. 4, line 7, col. 7, lines 32-50, col. 8, lines 4-12, lines 18-21, lines 28-45, figures 4, 11 & 12.	1-13
Y	US 4,352, 714 A (PATTERSON et al) 05 October 1982, abstract, col. 2, lines 20-34, lines 60-65, col. 3, lines 1-7, lines 36-42, lines 48-55.	1, 7

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,397,661 A (KAUN) 14 March 1995, see the whole document.	1-3, 6-7, 9-10
A	US 4,372,038 A (GOEBEL) 08 February 1983.	1, 7

Form PCT/ISA/210 (continuation of second sheet) (July 1998)★

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